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Biological Control Potential to Manage Hardwood Weed Species: *Chondrostereum purpureum*

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Strategic Importance

High demand for fiber and diminishing, available forest land is pressuring foresters to produce more fiber while protecting environmental concerns and other resource values. Many of the most productive sites also have the greatest potential for competition from unwanted vegetation.

Foresters are required to develop prescriptions (PHSPs) identifying preferred and acceptable tree species, free from deleterious brush and tree competition, within a specific time. Recently, many hardwoods have been recognized as acceptable crop trees. However, the wrong distribution or density will suppress commercially valuable conifer crop tree growth and reduce site productivity.

Fruiting body of Chondrostereum purpureum

Vegetation control is an essential part of integrated management plans. It is also very important to control vegetation on ski slopes, power, rail, pipeline and other rights-of-way. For example, British Columbia Hydro spends approximately $28 million annually on vegetation management of their rights-of-way. Over the last decade, more than 480,000 hectares of British Columbia's crown land have been brushed using manual cutting or girdling, and application of chemicals. Traditional use of chemicals is being increasingly restricted. In British Columbia, manual brushing is increasing while chemical control, having peaked in 1989/90, is decreasing. An alternative to chemicals is preferred due to public and environmental concerns.

Potential of *Chondrostereum purpureum* to Control Red Alder

On the Pacific Coast, red alder (*Alnus rubra*) is a primary invader of disturbed forest areas and is capable of dominating a range of sites. Manual cutting often encourages prolific, multi-stem sprouting from stumps or rhizomes. Manual cutting is generally economically not feasible because of alder's abiiity to resprout and grow more vigorously after cutting. Depending upon the site, the application of the commercial herbicide glyphosate, either as a paste (Carbopaste) or as a spray (Vision® or Roundup®), is considered effective for controlling alder competition. However, restrictions on herbicide use may increase, particularly on crown lands.

The results of greenhouse screenings and field trials indicate that the efficacy of *Chondrostereum purpureum* is comparable to the commercially used glyphosate for controlling target weed species.

A collaborative research program has been initiated between Canadian Forest Service, University of Victoria

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(Mycologic Inc.) and B. C. Hydro to test the effectiveness of the candidate mycoherbicide, *Chondrostereum purpureum*. The objective is to register this biocontrol agent for vegetation control on rights-of-way and to control competing hardwood vegetation in conifer reforestation sites.

Chondrostereum purpureum is poised to become North America's first biological control agent for use in integrated forest vegetation management strategies.

Characteristics of a Mycoherbicide

Mycoherbicides are formulations of plant pathogenic fungi that are applied directly to target weeds to repress or eliminate growth. The causal agent of the disease is cultured on artificial media, identified and then re-inoculated on the weed host. A preferred mycoherbicide would:

- be a local or native pathogen;
- not persist at greater than endemic levels;
- be subject to natural controls;
- have a potent virulence; and
- be applied in a cost efficient and environmentally safe manner.

Right of way: Chondrostereum purpureum offers viable alternative to chemical herbicides

Chondrostereum purpureum as a Mycoherbicide

Chondrostereum purpureum is a primary invader of wounds. The fungus causes sapwood stain, decay and eventually host death. However, upon weakening the host, it is quickly replaced by other, more aggressive saprobic fungi such as *Coriolus versiclor, Schizophyllum commune* and other microorganisms. These fungi may complete target weed mortality. This rapid succession of fungi ensures that *Chondrostereum purpureum* will not persist at high levels following local inundations.

Environmental Considerations

An extensive study in 1993 and 1994 of the natural occurrence in relation to its use as a biocontrol agent found that the added fructification of *Chondrostereum purpureum* was the same or less than naturally occurring levels.

Chondrostereum purpureum can only invade through fresh wounds or cut stumps. This limits spread and uncontrolled infections. The fungus is disseminated by short-lived basidiospores that are unlikely to pose a risk to non-target trees. In addition, as it is applied directly to specific hosts, it is not transported to adjacent species or to ground water.

Chondrostereum purpureum exists in all of North America's ecosystems. Its natural occurrence precludes the risks associated with the introduction of a foreign species.

To understand the population structure, the variation of ribosomal DNA (rDNA) in isolates from Europe, New Zealand, Canada and the U.S.A. was tested. The rDNA genes of basidiomycetes constitute a multigene family making it ideal for population studies. Initial results suggest no barriers to gene flow across North America and therefore a relatively low risk of moving an isolate from one region to another.

Chondrostereum purpureum is a wound plant pathogen and has not been shown to affect animal hosts. Toxicology laboratory tests

Competing hardwoods require vegetation management.

Chondrostereum purpureum restricts resprouting from red alder stumps

are ongoing to ensure that human health risks are assessed and a thorough taxonomic description is made available.

Mass Production

Quality control is vital in the mass propagation of any biocontrol agent. Two major considerations must be tested and controlled: stability and efficacy.

Stability

An important consideration in the production of a biocontrol agent is the possible introduction of pathogenic alleles from the virulent strain selected for biocontrol into the local population. Research is being done on advanced markers to ensure that the agent is stable during transportation.

Efficacy

Field and greenhouse tests on the efficacy of isolates are on-going. Experimental field trials are being established to obtain the most efficient, local isolates.

Research is showing that Chondrostereum purpureum offers a viable alternative to chemical herbicides.

Chondrostereum purpureum is applied to fresh stumps

Application

The treatment intent is to manage species and productivity for specific objectives, not to eradicate a weed species. Treatments must be considered as only one tool available for silvicultural prescriptions.

The formulation *Chondrostereum purpureum*, patented by the Canadian Forest Service, prevents desiccation of the mycelium until infection is established. Progress has been made to combine the cutting with the formulation application. The first full-scale field trial was established with the cooperation of B.C. Hydro in 1994.

Chondrostereum purpureum is cultured for application on single, dominate hardwood species. It will be applied to fresh stumps as a mycelial suspension in a paste formulation. Summer and autumn application can prevent wound healing and thus hasten mortality.

The best treatments can achieve up to 80% mortality. The slow mortality may have the advantages of:

- reducing invasion by other competing weed species;
- allowing other species to regenerate;
- providing less shock to crop trees; and
- providing less exposure to sunscald.

Continuing Research

Genetic markers will enable "DNA fingerprinting" of lead isolates and allow researchers to follow the environmental fate of released isolates.

Environmental persistence and risk analysis is an on-going task in many regions of Canada.

Conclusion

There is a strong potential for the formulation of the phytopathogenic fungus, *Chondrostereum purpureum*, to be used operationally as a biological control agent for hardwood weed species in conifer reforestation sites and rights-of-way.

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